



Schools and Sanitation Facility Distribution in the Tribal-rich District of Khargone: A Relationship of Statistical Significance

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ABSTRACT

Background: The infrastructure of rural or local India is upgrading with continuous efforts of government policies and increased awareness at the ground level. Many factors are notable for their impact on creating awareness of sanitation infrastructure. This study, therefore, studied different parameters to exhibit their effects on the distribution of toilets (DoT).

Methods: An MLR-based approach was employed to predict the cause of DoT in the Khargone district of Madhya Pradesh, India.

Results: All four factors, namely: Schools, Literacy, Male population, and Female population, correlated statistically with the DoT strongly; however, only 'Schools' ($p < 0.05$) was significant in predicting the DoT.

Conclusion: The study focussed on the factors affecting the DoT and inferred the exciting findings that can be used in addressing the existing complications in the upgradation of sanitation infrastructure in socially and economically backward areas.

Keywords: *Sanitation; Tribal; Schools; Literacy; Population; Multiple Linear Regression*

1. Introduction

On October 2, 2019, the Indian government declared that all of its states and union territories (UTs) were "open defecation-free," which is an unprecedented global achievement given the scope and length of time involved (5 years). This accomplishment has received widespread validation (NARSS 2018–2019) and citations. In rural India, toilet coverage increased from 40% in 2014 to almost universal within five years of the Swachh Bharat Mission's implementation (SBM). More than 60 crore (600 million) people changed their open defecation habits, and more than 10.5 crores (105 million) toilets were built. India's incredible accomplishment, where the rate of decline was above 12 percentage points a year between 2015 and 2019, immensely helped to reduce open defecation globally (Secretary-General, Global Sustainable Development Report, 2019).

With 6.02 lakh villages, 711 districts in the rural category, and 4,360 cities (98% of all Indian cities) achieving ODF status, the start of SBM in 2014 resulted in a dramatic increase in sanitation in both rural and urban India. As a result, it should be emphasized that the programme not only put an emphasis on building restrooms but also increased the use of restrooms, with over 95% of rural residents and more than 98% of urban residents routinely using restrooms. Over 10.76 crore (107.6 million) family toilets have been constructed in rural India, and

numerous rural areas have moved beyond ODF, with 63.9% of the rural population using Solid and Liquid Waste Management (SLWM). More than 6.2 million individual household toilets and more than 6 lakh community/public toilets have been built in urban India by exceeding the set goals. The next phase of the SBM is now focused on achieving ODF+ (aimed at sustaining and maintaining the toilets installed) and ODF++ (emphasizing sludge and septage management), with 2,187 cities (49%) reaching ODF+ status and 551 cities (12%) achieving ODF++ status.

India will have completed the sanitation-related Millennium Development Goals (MDGs) of the United Nations (MDG 2000-2015). India will be able to achieve the 2030 Sustainable Development Goals (SDGs) for improved sanitation thanks to the ongoing programmes in the sanitation sector (United Nations, 2015). Therefore, this study aims to gather and analyze the cleanliness data of a tribal-rich district of Khargone, Madhya Pradesh, to assess the development factors of sanitation facilities. These data are crucial for a compelling study into the development of rural sanitation facilities, so creating a method that works well is necessary.

2. Materials and Methodology

2.1 Study area and data

The study was conducted in the Khargone district of Madhya Pradesh state, located at 21°50' 00.6900" N and 75°36'53.9640" E, with a geographical area of 8,030 square kilometres in the central part of India. The study aims to analyze the DoT, as a facility, in different parts of the district and the reasons governing the same. The primary or field data were collected from different locations (sample area of 2 sq.km) in the district between August 2018 and October 2018. Thus, a total of 25 responses were collected from 25 each location in 90 days. In this study, multiple regressions analysis is performed between the dependent variable, DoT (n) and a set of independent variables such as Schools (n), Literacy (%), Male population (n), and Female population (n). These data were recorded physically by simple sampling methodology (Banerjee & Chaudhury, 2010). The population's literacy was calculated per the standards laid by the Government of India (Natarajan, 1972).

Table 1: The table showing the recorded data of the field survey between August and October 2018

| Schools (n) | Literacy (%) | Male population (n) | Female population (n) | Distribution of Toilets (n) |
|-------------|--------------|---------------------|-----------------------|-----------------------------|
| 3 | 67.14 | 27 | 44 | 8 |
| 6 | 60.43 | 36 | 33 | 7 |
| 0 | 53.67 | 28 | 48 | 6 |
| 2 | 47.70 | 38 | 35 | 6 |
| 2 | 88.51 | 40 | 42 | 3 |
| 6 | 53.71 | 39 | 44 | 6 |
| 0 | 92.45 | 41 | 45 | 4 |
| 3 | 51.08 | 25 | 20 | 6 |

| | | | | |
|---|-------|----|----|----|
| 4 | 85.13 | 50 | 27 | 10 |
| 5 | 75.60 | 50 | 32 | 9 |
| 2 | 68.04 | 45 | 32 | 8 |
| 2 | 60.48 | 44 | 38 | 7 |
| 3 | 60.48 | 54 | 38 | 7 |
| 2 | 65.21 | 37 | 32 | 4 |
| 4 | 47.70 | 57 | 29 | 6 |
| 4 | 59.63 | 52 | 30 | 7 |
| 4 | 68.10 | 32 | 35 | 8 |
| 2 | 42.56 | 58 | 42 | 5 |
| 2 | 78.21 | 45 | 33 | 7 |
| 2 | 80.57 | 57 | 48 | 9 |
| 3 | 53.71 | 58 | 42 | 6 |
| 4 | 76.61 | 53 | 46 | 9 |
| 3 | 68.10 | 39 | 37 | 8 |
| 3 | 53.71 | 51 | 30 | 6 |
| 6 | 67.14 | 44 | 41 | 8 |

Source: Field Survey in Khargone District, Madhya Pradesh

2.2 Empirical method

The study employed MS-Excel tool and linear mathematical model to explore the relationship between the (DoT) in the district and different demographic factors; the algorithm, thus followed is as follows:

$$Y_{DoT} = \alpha S + \beta L + \gamma M + \delta F + \varepsilon$$

Where Y_{DoT} is the dependent variable denoting DoT and $\alpha, \beta, \gamma,$ and δ respectively, are the coefficients of Schools, Literacy, Male population, and Female population. The constant term or intercept is denoted as ' ε '. The multiple regression analysis introduces one independent variable at each stage. The coefficient of correlation (multiple R) and coefficient of determination (R^2) is calculated mainly to assess the percentage of explanation provided by each independent variable on the dependent variable.

3. Results and Discussion

The parameters used in the study significantly affect the DoT in the district. These descriptors were studied in an MLR model to display their role in predicting the availability and distribution of toilets in the district:

3.1 Effect of different climatic factors on the DoT

The factors incorporated in the study to build a relationship with the DoT were found to be either positively or negatively correlated with the latter. All the factors, Schools (0.486379324), Literacy

(0.032803616), Male population (0.021880026), and Female population (0.001496067) are found to be positively correlated with the DoT, which means that increase in any of these will increase the DoT. However, only the 'Schools' factor is significant in predicting the DoT (p-value less than 0.05). Rest, all other factors are insignificant in predicting the DoT (with a p-value higher than 0.05). The entire output data of multiple linear regression is reflected in Table 2.

The significant DoT-associated factor, 'Schools,' was also studied for its impact on the dependent variable, where it exhibited a similar trend. The representation of this relationship is shown in Figure 1 with the help of an X-Y plot. It can be inferred that in these areas where the study was done, these are the number of schools impacting the DoT significantly. However, the factors like Literacy and population strongly correlate with the dependent variable, but they are not significant in their contribution towards the DoT.

Table 2: The output summary of the MLR analysis of the DoT-associated factors

SUMMARY OUTPUT

| Regression Statistics | | | | | |
|------------------------------|--|--|--|--|-------------|
| Multiple R | | | | | 0.503960909 |
| R Square | | | | | 0.253976598 |
| Adjusted R Square | | | | | 0.104771918 |
| Standard Error | | | | | 1.649073857 |
| Observations | | | | | 25 |

| ANOVA | | | | | |
|--------------|----|-------------|-------------|-------------|----------------|
| | Df | SS | MS | F | Significance F |
| Regression | 4 | 18.51618283 | 4.629045707 | 1.702202622 | 0.189016214 |
| Residual | 20 | 54.38889173 | 2.719444587 | | |
| Total | 24 | 72.90507456 | | | |

| | Coefficients | P-value |
|-----------------------|--------------|-------------|
| Intercept | 2.183985305 | 0.448454819 |
| Schools (n) | 0.486379324 | 0.041133409 |
| Literacy (%) | 0.032803616 | 0.216519557 |
| Male population (n) | 0.021880026 | 0.529898488 |
| Female population (n) | 0.001496067 | 0.976073462 |

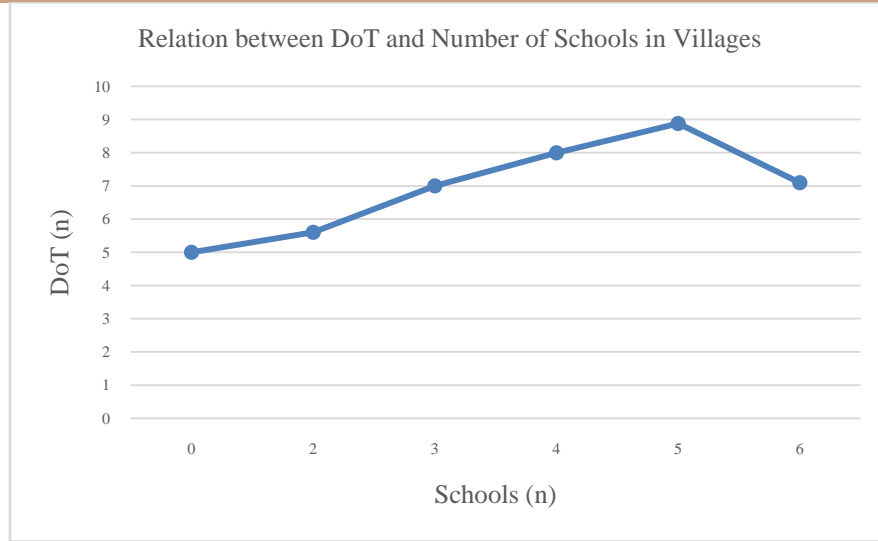


Figure 1:Relation between DoTs(n) and Number of Schools (n) in Villages

3.2 Equation of Prediction

The multiple regression model has provided the coefficient values to each independent variable which can be aggregated to form the Equation of Prediction;

$$Y_{DoT} = 0.486379324S + 0.032803616L + 0.021880026M + 0.001496067F + 2.183985305$$

The factors, Literacy, Male population and Female population, are not noteworthy in the equation as it does not hold any significance in the prediction. The data model's coefficient of correlation (multiple R) is also reasonable, with a value above 0.50 (Table 2). It is significant in assessing the percentage of explanation provided by each independent variable on the dependent variable.

4. Conclusion

Although many studies and reports highlight India's progress in the sanitation sector, this study examined the causes of the rise in sanitation facilities in a district with a high concentration of tribal people. It projected what needs to be done to improve the rural and tribal sanitation infrastructure. The report can also be considered an analysis of the policies, programmes, and alignment of the Government of India with the relevant SDGs. The SBM and Har Ghar Jal programmes, among others, have strong political backing from both the Central and State levels of government in India. Firm policy and legal frameworks are necessary for providing all people with comprehensive, sustainable, and accessible sanitation services. These frameworks should be reviewed regularly to ensure they keep up with new technologies, aspirations, and society's changing needs and challenges.



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